

Nor will the government further press its appeals presently pending in the 5th and 8th Circuits. These are respectively *Holder v. United States*, and *Wallace v. United States*. Also, no appeal will be prosecuted in any other pending cases decided adversely to the government on the same issue involving similar facts. Finally, all similar cases now in litigation or under audit will be reviewed to see if they should be conceded.

Implementing instructions will be issued to field personnel—if necessary on a state-by-state basis—as soon as possible. In addition, appropriate modifications of existing regulations will be required consistent with these decisions.

Drowning and Hyper-Ventilation Syndrome

To the Editor: I was recently involved in a death by drowning that makes me feel that hyper-ventilation syndrome is a not uncommon form of death. The exact circumstances make me feel that our standard forms of resuscitation need some important improvement. As an M.D. and certified NAUI instructor, I feel obligated to call attention to these facts.

I will recount the shocking and almost unbelievable death so that others may be possibly saved under similar circumstances. I was taking a friend on an ocean boat dive off Catalina in May of 1968. He had a fair amount of pool practice, but only one previous ocean dive.

He was a young (30-year-old) former athlete and in excellent physical condition, but had shown some moderate fear on his first dive, about four months prior. He had done some thrashing to reach the ship's ladder and complained of a moment's "blackout." This "blackout" was apparent to no one but himself, other than as a possibly dazed or exhausted expression, so not much was thought of it.

There was no apparent fear on the present dive. On entering the water, I re-checked his gear and he signaled "OK." I had planned to take him in to shore since it was a calm day and make a very gradual submergence, because on the previous day

he had experienced difficulty in getting down, claiming not enough weights (it was a two-day trip this time).

We snorkled over toward shore, picking clear spots through the kelp. We were about 150 feet from the boat and 50 feet from the shore. I was taking the lead since he appeared to want this and was about ten feet ahead when he called, "Hey, Doc, I think I'll go back to the boat." This surprised me because it was a beautiful day, nice clear water and we were almost to the shore.

I swam back to him and, by this time, he had swum out of the clear passage we were following, to the edge of the kelp (as though he were thinking of going in a direct line through the kelp toward the boat).

We faced each other about two feet apart. I asked him, "What do you want to go back for?" He did not remove the snorkel from his mouth or attempt to reply. He just looked at me. Under the circumstances, I felt it better not to push my question and decided to go along with his desire to return to the boat. I indicated going back through the clear passage instead of through the kelp. His breathing at this time sounded normal and there was nothing to indicate trouble. However, he turned toward the kelp and the boat instead of the clear passage.

I pulled him gently by the shoulder and again indicated the clear space. He again turned toward the kelp (there was about 15 to 20 feet of it and then clear water to the boat). The boat had stood a little off shore because of some current and rocks.

At this point I decided to be a little foresighted and get ready for trouble if it should come. There was no real reason to assume he wouldn't swim back to the boat without difficulty as he had done the day before. At the worst, I felt I might have to help him get untangled from the kelp or some such. I put two short puffs in my safety vest for slight added bouyancy, put the mouthpiece of my regulator in my mouth and looked up to see what my companion was doing. He was nowhere to be seen.

I looked under the water ahead of me in the direction he had taken, and there he was, about 6 feet ahead and 5 feet down, slowly sinking.

I swam down to him with a little extra hard kicking. The small amount of air in my vest was no real obstacle. He was not tangled in kelp but he was unconscious and I noticed when I got him to the surface, he was a little heavy (lungs already

filled with water and, perhaps, an extra weight on his belt). I wasted a little time getting his regulator mouthpiece in his mouth. I noticed a small amount of vomitus drifting from his mouth during this procedure. I then pulled the fill cord on his safety vest. I took the regulator out of his mouth since he obviously was not using it, filled his lungs once amply with mouth-to-mouth, and called to the boat for help. He could not have been under water for more than 40 seconds, yet he was completely unconscious and nonreactive.

The rest of the rescue operation was done very efficiently since there was another NAUI instructor aboard, and the skipper was very capable as were other members of the club (another M.D. was also present). Help arrived within a minute or two, during which time I continued to give a few mouth-to-mouth breaths. The rescue party brought several rubber inner tubes with nylon rope attached and we were pulled to the boat very swiftly. I continued mouth-to-mouth during this time and good inflation of lungs was obtained as I could feel the chest expand and air and water came gurgling out after.

Mouth-to-mouth and heart massage (approximately a 2 to 10 ratio) was commenced on the tail gate of the boat, with the victim in supine position, head back, jaw forward. Head was at times placed sideways to facilitate spillage of water from lungs on exhale.

At onset of this period on the tail gate victim was unconscious and pupils widely dilated. After 15 minutes of resuscitation on tail gate, victim did not respond and he was therefore lifted to deck of the ship where procedure was continued for another 20 minutes before he was pronounced dead.

Nearly every physician has seen numerous instances of what is called hyperventilation tetany in nervous patients who hyperventilate in an attack of anxiety. Typical treatment is simply to calm them down or have them breathe into a paper bag to prevent excess loss of carbon dioxide with resultant acid-base imbalance in the blood and body, and production of muscle spasm and possible sudden loss of, or impaired consciousness.

These are cases of very minor importance on dry land; but in the water, as probably in this instance, sudden loss of consciousness, impaired consciousness, or muscle spasm can be fatal.

Some people are much more susceptible than others, but loss of consciousness and muscle

spasm probably could be induced in almost everyone with sufficiently prolonged hyperventilation. Some hyperventilation is very common in instances where people become panicked in the water, and death from such a cause is probably not uncommon. Unfortunately, it has been labeled in the past as simply "accidental death from drowning."

Related loss of consciousness as in shallow water blackout or the old trick kids often play of taking a few deep breaths and holding it while someone else puts his arms around subject's chest with resultant disturbance of bodily chemical-physical mechanisms and sudden loss of consciousness, is familiar to many.

Autopsy in the present case showed no physical impairment except water in the lungs and "accidental death from drowning preceded by hyperventilation syndrome." Since I had been on several mountain-climbing forays with this young man in the months preceding his death, during which he was exceedingly vigorous and not easily winded, there can be little doubt as to the good condition of his heart and lungs.

A further important question now arises: Why should death have occurred in this young man in excellent physical condition? He was only under water for 40 seconds at the most. Mouth-to-mouth resuscitation was inaugurated in perhaps another 40 seconds. Heart massage was begun within three minutes. Good standard procedures were applied throughout. He should not have died.

I believe the answer is that an improvement in standard procedures is in order. A suggestion for a change that has occurred in my mind is that mouth-to-mouth resuscitation should be done as it was until the victim is on a solid platform, such as a boat or dry land; after which, I believe, he should be placed face down in the Shafer position, head turned to the side, airway clear, jaw forward. Pressure should be applied from behind on the lower ribs. If possible, the body should be on a gentle incline with head slightly lower to facilitate drainage of water. Pressure should be applied to the lower ribs intermittently for respiration. It is to be noted that such pressure, properly applied, also constitutes a form of heart massage. This should be carried on for about 30 seconds to clear the lungs of excessive water and then the standard procedure of mouth-to-mouth respiration with patient on his back, head thrown back, two respirations to ten presses of external heart massage should be carried out. I believe that if this had

been done instead of the procedure followed, this young man might well have recovered.

In reference to this above procedure it is well known that electrolyte imbalance and damage to lung tissue from aspiration of water, and not simple suffocation, are most often involved in deaths from drowning. Because of this fact it is felt that when the lungs are flooded, one has only six minutes in ocean water and four minutes in fresh water before changes in blood electrolyte balance cause irreversible changes in the body and brain and consequent death. I also refer you to the recent fascinating work done by Dr. Johann Klystra, the Dutch scientist, now working on the same research for the Department of the Navy. He expressed the opinion that death was not caused by fluid in the lungs in itself, but was due to electrolyte imbalance caused by differences in solutions in the lungs compared with the blood. He produced a solution which closely approximated the blood (like Ringer's solution), increased the oxygen content, and kept experimental animals alive for extended periods of time under water. When their lungs were drained, the animals were able to carry on without impairment. It therefore seems likely that the matter of removing fluid from the lungs becomes of paramount importance in the first four to six minutes.*

*The possibility of direct damage to the delicate tissue lining the lungs from foreign solutions like sea and fresh water which do not approximate the blood does exist.

Summary

1. A case of sudden death by drowning probably due to hyperventilation syndrome from panic was probably observed.

2. This is likely an unrecognized and not uncommon form of death from drowning and should be warned against.

3. Improvement of standard resuscitation procedures to include definite early clearing of the lungs of water to avoid electrolyte imbalance and damage to delicate lung tissue would seem desirable and probably imperative.

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*This last included to show that even in articles holding that removal of water from lungs to be of little importance, damage to lungs by water is considered very important.

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